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Bat Fleas (Siphonaptera: Ischnopsyllidae) of California

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Abstract.—Bat fleas (Siphonaptera: Ischnopsyllidae) of California by G. E. Haas, A. J. Beck, and P. Q. Tomich. *Bull. Southern California Acad. Sci.*, 82(3):103–114, 1983. A key is given for *Sternopsylla distincta texana, Nycteridopsylla vancouverensis, Myodopsylla palposa, M. collinsi,* and *M. gentilis*; synonymy is given. Additional records total two, seven, 27, eight, and 52, respectively. Maps show *M. gentilis* has the widest distribution. Associations with 12 species of bats are tabulated; *S. d. texana* preferred molossids; *N. vancouverensis, Myotis californicus; Myodopsylla palposa, Antrozous pallidus; Myodopsylla collinsi, Myotis lucifugus*; and *Myodopsylla gentilis, Myotis yumanensis. Myodopsylla gentilis* had the most records (61), specimens collected (459), and the highest average per bat examined (3.0).

Introduction

In the past 50 years the large bat fauna of California attracted many investigators, some of whom managed to collect fleas from these mammals. Our enthusiasm in pursuing this long-term study of bat fleas is due in part to the activities of these early students of California bats. Today 23 species of bats are known for the state (Hall 1981), and fleas representing five taxa are recorded from 12 of these species. Future studies are likely to add at least one more flea. The purpose of our study is to collate all published records and the 96 additional ones that we obtained from our own field work and studies of museum and personal collections.

Methods

Field studies were initiated in 1941 by Tomich, along with collation of information from early publications and collections. New material was gathered from several counties in central California and a major study site at Calaveras Dam in Alameda County. This work was suspended in 1946, but some incomplete data were published (Holdenried et al. 1951). Beck was a principal in new studies begun in 1956 and these continued, with some interruption, until 1973. Field operations were then wide ranging but concentrated at several bat roosts in Colusa, Napa, Yolo, and Yuba Counties. Haas assumed a leading role in the studies in 1972, following up with the intensive research required for integration and completion of the entire long-term project.

Bats were collected by shooting, netting, and by hand. Different species were bagged separately, and fleas were later removed and preserved in 70% ethanol. All flea specimens were mounted on slides. Nearly all those obtained on loan were already permanently mounted. Our unmounted specimens were routinely treated in 10% KOH solution, dehydrated in ethanol, and cleared in oil of cloves before being mounted in Canada balsam. For identification of the fleas, the illustrated publications of Holland (1949), Hopkins and Rothschild (1956), and Smit (1958) were especially valuable. Our key uses morphological characters that

are illustrated in Hopkins and Rothschild, although not necessarily for the same taxa.

For each of the five taxa of fleas, host associations are summarized in Table 1, and collecting localities are mapped in Figs. 1A, B, and C to show distributions in the state. In the separate accounts of each flea are synonymy in California, total ranges reported in the literature, and additional California records in full. The numbers of bats examined and infested are not listed as the data are not usually available. For selected surveys of *Myodopsylla palposa* (Rothschild) and *M. gentilis* Jordan and Rothschild, however, we discuss the average number of fleas per bat examined.

Most specimens collected by the authors are in their personal collections, but some were deposited in other collections. The names of the museums and persons whose collections provided material listed among the additional California records were abbreviated and listed parenthetically. The corresponding names of collections and abbreviations are Albert J. Beck (AJB); California Academy of Sciences (CAS); Center for Disease Control, USPHS, Fort Collins (CDCFC); California Department of Health, Division of Vector Control (CDHVC); Deane P. Furman (DPF); E. W. Jameson, Jr. (EWJ); Frank J. Radovsky (FJR); Gorgas Memorial Laboratory (GML); Los Angeles County Museum of Natural History (LACM); P. Quentin Tomich (PQT); and Stanford University Museum of Natural History (SUMNH).

Results and Discussion

Morphology

The keys to the species of bat fleas in the Rothschild Collection (Hopkins and Rothschild 1956) include all five bat fleas recorded for California. Our key uses combinations of characters that we found most useful for the identification of these five forms. A species that probably occurs in California, i.e., *Nycteridopsylla intermedia* Lewis and Wilson, has the same characters as given for *N. vancouverensis* Wagner, but the illustrated key of Lewis and Wilson (1982) indicates that the head is rounded rather than flattened and has a shorter row of spiniform bristles. Lewis (1978) revised the key to species of *Myodopsylla* by Hopkins and Rothschild (1956) to include *M. borealis* Lewis from Minnesota and Montana, *M. globata* Holland (male unknown) from southern Mexico, and *M. setosa* Johnson from Peru. Méndez and Lemke (1979) followed with the description of *M. tropica* from Colombia. Additional collections of these four species are likely to include localities closer to California but probably not within its boundaries.

Key to the Bat Fleas of California

1. Pale band on frons 3
   No pale band on frons 2
2. A single unmodified antepygidial bristle .....
   ..... 1. *Sternopsylla distincta texana*
   A false comb of a number of short, spiniform antepygidial bristles ....
   ..... 2. *Nycteridopsylla vancouverensis*
3. False combs on abdominal terga I–II 4
   No false combs on abdominal terga ..... 3. *Myodopsylla palposa*

Table 1. Flea-bat associations in California.

Flea	Bat Host											
	1. *Myotis lucifugus*	2. *Myotis yumanensis*	3. *Myotis velifer*	4. *Myotis evotis*	5. *Myotis thysanodes*	6. *Myotis volans**	7. *Myotis californicus*	8. *Eptesicus fuscus*	9. *Plecotus townsendii*	10. *Antrozous pallidus*	11. *Tadarida brasiliensis*	12. *Eumops perotis*
1. *Sternopsylla distincta texana*											X	X
2. *Nycteridopsylla vancouverensis*					X		X		X			
3. *Myodopsylla palposa*		X						X	X	X		
4. *Myodopsylla collinsi*	X	X	X							?		
5. *Myodopsylla gentilis*	X	X		X	X					X	X	

*One unidentified flea recorded by Dalquest and Ramage (1946).

4. False combs of abdomen only well developed on terga I and II; preoral tuber with slight, indistinct bend; ♂ 1 large and 1 small, thickened, shortened bristles (spiniforms) on acetabular projection; ♀ sternum VII with prominent, usually truncate dorsal lobe; anal stylet usually less than 2.5 times as long as broad ..... 4. *Myodopsylla collinsi*
False combs of abdomen well developed on several terga in addition to terga I and II; preoral tuber usually with noticeable bend; ♂ 2 long and 1 short unmodified bristles on acetabular projection; ♀ sternum VII without well-developed dorsal lobe; anal stylet 2.5 or more times as long as broad ..... 5. *Myodopsylla gentilis*

Synonymy, Records, and Notes

1. *Sternopsylla distincta texana* (C. Fox 1914)
(Fig. 1A)

Ischnopsyllus texanus C. Fox, 1914, U.S. Pub. Hlth. Hyg. Lab. Bull. 97:16, 17 (1 ♀, Pecos, Texas, from *Nyctinomus mexicanus*).

Sternopsylla texana (C. Fox). Augustson, 1943, Bull. So. Calif. Acad. Sci. 42:87 (City of Los Angeles, from *Eumops perotis californicus* and *Tadarida mexi-*

cana). Hubbard, 1943, Pacif. Univ. Bull. 39(8):7. Hubbard, 1947, Fleas of Western North America, pp. 379 (Fig. 235), 380, 386, 508. Hopkins & Rothschild, 1956, Catalogue of the Rothschild Collection of Fleas in the British Museum (Natural History), Vol. II, p. 221 (1 ♀, Los Angeles, from *Eumops perotis californicus*). Jellison & Senger in Taylor & Clark, 1976, Papers in Honor of Jerry Flora, p. 120 (1 ♂, San Jose, from *Tadarida mexicana*).

Sternopsylla distincta texana (C. Fox). Johnson, 1957, Mem. Ent. Soc. Wash. No. 5:100, 101. Lewis, 1974, J. Med. Ent. 11:531.

Total range.—Alabama, Arizona, California, Florida, Georgia, New Mexico, Oklahoma, South Carolina, Texas, Utah, México (D.F., Michoacán, Nuevo León).

Additional California records.—San Benito County, Idria, 6.4 km N (Silver Creek): one ♀, *Eumops perotis,* 9.IX.1945, S. B. Benson, det. Prince (PQT). Santa Clara County, San Jose: one ♀, *Tadarida mexicana,* no date, J. W. Anderson (SUMNH).

Host synonymy.—Nyctinomus mexicanus = *Tadarida brasiliensis. Tadarida mexicana* = *T. brasiliensis.*

Although this bat flea ranges widely in North America (Lewis 1974) and has been collected in large numbers, especially from *Tadarida brasiliensis* and its caves (Jellison and Senger 1976), it is relatively poorly known in California. Published records pertain to only two counties (Los Angeles and Santa Clara) and identify only two hosts (Table 1). We could add only one more county, with a locality between the two already published (Fig. 1A). Some collection dates are missing. The only months recorded are March and September. Both recorded hosts are molossid bats. Johnson (1957) indicated that all three subspecies of *S. distincta* (Rothschild) are associated with molossid bats.

2. *Nycteridopsylla vancouverensis* Wagner 1936
(Fig. 1A)

Nycteridopsylla vancouverensis Wagner, 1936, Z. Parasitenk. 8:658 (4 ♂♂, 4 ♀♀, Vancouver, British Columbia, from *Lasionycteris noctivagans*).

Eptescopsylla vancouverensis (Wagner). Holdenried, Evans & Longanecker, 1951, Ecol. Monogr. 21:14 (2 ♀♀, Alameda County, Calaveras Dam, from *Corynorhinus rafinesquii,* fleas det. P.Q.T.).

Nycteridopsylla vancouverensis Wagner. Hopkins & Rothschild, 1956, Catalogue of the Rothschild Collection of Fleas in the British Museum (Natural History), Vol. II, p. 235 (2 ♂♂, 2 ♀♀, Plumas County, Quincy, from *Myotis californicus*). Jellison & Glesne, 1967, Index to the Literature of Siphonaptera of North America Suppl. 2, p. 225. Lewis, 1974, J. Med. Ent. 11:530. Jellison & Senger in Taylor & Clark, 1976, Papers in Honor of Jerry Flora, p. 98 (1 ♀, San Jose, from *Plecotus townsendii*). Lewis & Wilson, 1982, J. Med. Ent. 19:613 (published records for Alameda, Plumas, and Santa Clara Counties listed; map with three localities in California).

Total range.—California, Nevada (?), Oregon, Washington, Canada (British Columbia).

Additional California records.—Colusa County, Wilbur Springs: one ♀, *Plecotus townsendii,* 14.I.1965, A.J.B. (AJB). Napa County, Angwin, 0.8 km S: one ♀, *Myotis thysanodes,* 1.IV.1946, W. W. Dalquest (PQT). Plumas County, Quincy:

all from *Myotis californicus,* one ♂, three ♀♀, 12.II.1949; one ♂, 30.XII.1949; one ♀, 15.III.1951, E. W. Jameson, Jr. (EWJ). Yolo County, Capay: one ♀ (gravid), *M. californicus,* 19.XII.1963, A.J.B. (AJB). Unknown locality: one ♀, *M. californicus,* 24.I.1962, C. J. Parkinson, det. A. J. Beck (AJB).

Host synonymy.—Corynorhinus rafinesquii = Plecotus townsendii.

This West Coast bat flea occurs on its hosts, chiefly *Myotis californicus* and secondarily *Plecotus townsendii,* only in the cooler months. Since the recent description of *N. intermedia* Lewis and Wilson (1982) from three interior localities including Virginia City, Nevada (only 31 km from California) and Big Bend National Park, Texas, the record of *N. vancouverensis* from the Nevada Test Site (Beck and Allred 1966) seems questionable. In fact, we suspect that *N. intermedia* ranges from Nevada into the drier parts of California that border on the Great Basin.

The Plumas County specimens of *N. vancouverensis* recorded by Hopkins and Rothschild (1956) came from the series presently in the Jameson Collection.

3. *Myodopsylla palposa* (Rothschild 1904)
(Fig. 1B)

Ceratopsylla palposus Rothschild, 1904, Novit. Zool. 11:652, 653 (2 ♀♀, Cowichan, near Duncan, Vancouver Island, British Columbia, from *Vespertilio fuscus*).

Myodopsylloides piercei Augustson, 1941, Bull. So. Calif. Acad. Sci. 40:104, 105, 107 (Pl. 7) (4 ♂♂, 3 ♀♀, Santa Barbara County, Santa Cruz Island, from *Antrozous pallidus pacificus* and 1 ♂, same locality, from *Corynorhinus rafinesquii intermedius*). Augustson, 1943, Bull. So. Calif. Acad. Sci. 42:86, 87 (added Los Angeles County, San Gabriel Mountains, Soledad Canyon and Santa Clara County, San Jose, from *Antrozous pallidus pacificus*). Hubbard, 1943, Pacif. Univ. Bull. 39(8):7. Costa Lima & Hathaway, 1946, Monogr. Inst. Oswaldo Cruz No. 4:171, 354.

Rhinolophopsylla palposa Rothschild. Hubbard, 1943, Pacif. Univ. Bull. 39(8):7.

Myodopsylloides palposa (Rothschild). Hubbard, 1947, Fleas of Western North America, pp. 376–378, 385, 508, 520, Fig. 233. Orr, 1954, Proc. Calif. Acad. Sci. 28:234, 235 (three specimens, San Luis Obispo County, from *Antrozous pallidus*).

Myodopsylloides palposus (Rothschild). Holland, 1949, Proc. Ent. Soc. B. C. 45: 13. Holland, 1949, The Siphonaptera of Canada, pp. 181, 182. Augustson & Wood, 1953, Bull. So. Calif. Acad. Sci. 52:49, 50, 56 (1 ♀, Madera County, San Joaquin Experimental Range, from *Myotis yumanensis sociabilis,* and 3 ♂♂, 1 ♀, same locality, from *Antrozous pallidus pacificus*). Jellison, Locker & Bacon, 1953, Index to the Literature of Siphonaptera of North America Suppl. 1, p. 129. Jellison, Locker & Bacon, 1953, J. Parasitol. 39:618.

Myodopsylla palposa (Rothschild). Hopkins & Rothschild, 1956, Catalogue of the Rothschild Collection of Fleas in the British Museum (Natural History), Vol. II, p. 240 (1 ♂, Los Angeles County, Soledad Canyon, and 1 ♀, Santa Clara County, San Jose, both from *Antrozous pallidus pacificus* and det. by Augustson as *Myodopsylloides piercei*). Jellison & Glesne, 1967, Index to the Literature of Siphonaptera of North America Suppl. 2, p. 212. Lewis, 1974, J. Med. Ent. 11: 530. Jellison & Senger in Taylor & Clark, 1976, Papers in Honor of Jerry Flora, p. 95 (1 ♂, 1 ♀, Alameda County; 1 ♀, Monterey County; and 1 ♂, 1 ♀, unknown

locality, all from *Antrozous* sp. [=*A. pallidus*]; 3 ♂♂, San Jose [Santa Clara County], and 1 ♀, Tuolumne County, both collections from *Antrozous pallidus pacificus*). Lewis & Wilson, 1982, J. Med. Ent. 19:605. Lewis, 1978, J. Parasitol, 64:524–527.

Ceratopsylla palposus Rothschild. Smit & Wright, 1978, A List of Code Numbers of Species and Subspecies of Siphonaptera, pp. 8, 26.

Total range.—California, Canada (British Columbia).

Additional California records.—All from *Antrozous pallidus* except for two collections from *Eptesicus fuscus* indicated below. Alameda County, Livermore: one ♂, one ♀, 1.III.1943, B. E. Sagal (DPF). Colusa County, Wilbur Springs: one ♂, one ♀, 16.V.1964, A.J.B. (AJB). Kern County: two ♂♂, 6.VI.1948, collector?, det.H. E. Stark 1949 (CDCFC). Madera County, Knowles: one ♀, 12.VII.1952, Keith Murray, det. B. K. (?Keh) (CDHVC). Marin County, Tomales Bay, Marshall: two ♀♀, *Eptesicus fuscus,* 10.IX.1944, J. C. Couffer, det. L. C. Ryan (LACM). Napa County, Pope Valley (Store): one ♂, one ♀, 2.VI.1964, A.J.B. (AJB); St. Helena, 0.8 km S (Bourne Estate): one ♂, one ♀, 28.VII.1955, K. F. Murray, det. A. M. Barnes 1956 (CDHVC). Sacramento County, Folsom, 3.2 km NW: three ♂♂, nine ♀♀, 24.VI.1941, P.Q.T., det. F. M. Prince 1946 (PQT, but one ♂, one ♀, CDCFC); Sloughhouse (A. V. Signoretti Ranch): one ♀, 18.IX.1964 and one ♀, 7.X.1964, A.J.B. (AJB). San Luis Obispo County, Paso Robles: one ♀, *E. fuscus,* 23.VI.1945, S. B. Benson, det. F. M. Prince 1946 (PQT); Shandon, 7.2 km NE, 396 m elev.: one ♀, 20.IX.1947, R. T. Orr, det. H. E. Stark 1949 (CAS); (Granger Ranch): one ♂, two ♀♀, 15.IV.1949, collector?, det. H. E. Stark 1949 (CDCFC). Siskiyou County, Montague (Hart Ranch): two ♀♀, 15.V.1964 and one ♂, 20.VII.1964, A.J.B. (AJB). Tuolumne County, Long Barn: one ♂, one ♀, 29.V.1939, R. T. Orr, det. Prince & Good (N. E. Good). Yolo County, Capay (Capay School): two ♀♀ (one gravid), 21.IV.1964; one ♂, one ♀, 13.V.1964; two ♂♂, three ♀♀ (two gravid), 25.VI.1964; one ♂, 25.VIII.1964; and one ♂, one ♀, 25.IX.1964, A.J.B. (AJB); Davis (Univ. Calif.): one ♂, one ♀, 29.II.1964 and one ♀ (gravid), 30.V.1964, A.J.B. (AJB); Woodland, 8 km NW: two ♀♀, 16.V.1963, A.J.B. (AJB). Yuba County, Smartville, 1.6 km E: two ♂♂, three ♀♀, 8.VI.1964; one ♂, one ♀ (gravid), 31.VIII.1964; and one ♀, 29.X.1964, A.J.B. (AJB).

Host synonymy.—Corynorhinus rafinesquii intermedius = *Plecotus townsendii. Vespertilio fuscus* = *Eptesicus fuscus.*

In California *M. palposa* ranges widely on *Antrozous pallidus* (pallid bat) (Fig. 1B, except Marin County). In southern British Columbia, however, *Eptesicus fuscus* (big brown bat) was the only host recorded for six collections listed by Holland (1949) and Hopkins and Rothschild (1956). Only three female specimens were collected from the big brown bat in California. Also the female from *Myotis yumanensis* and the male from *Plecotus townsendii* are obviously strays from *A. pallidus* (see especially Augustson and Wood 1953). Some published records do not specify sex (Orr 1954) and number of specimens (Augustson 1943, cf. Hopkins and Rothschild 1956), but at least 13 males, nine females, and three unknowns have been collected from *A. pallidus.* These data plus our records from the pallid bat total 84 specimens (47 females) indicating that in California *M. palposa* prefers *A. pallidus.* The fleas were not numerous on the bats, however. The maximum average number of *M. palposa* specimens per pallid bat examined during the study

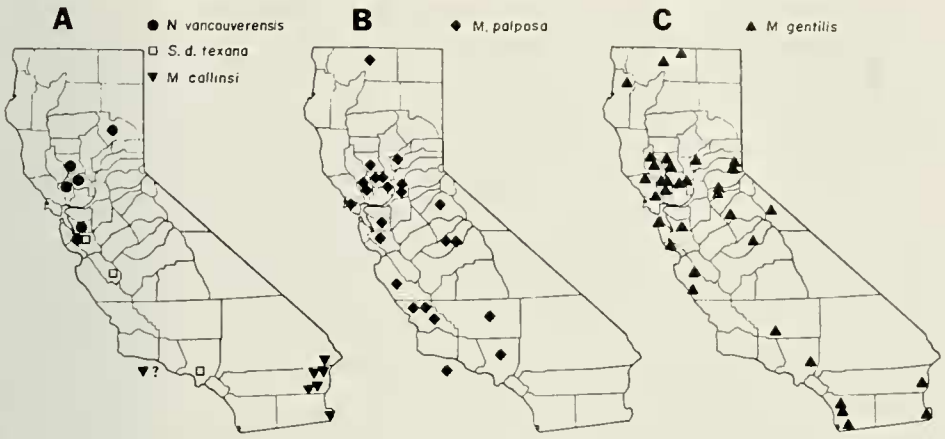

Fig. 1. Collecting localities in California of—(A) *Nycteridopsylla vancouverensis* Wagner, *Sternopsylla distincta texana* (C. Fox), and *Myodopsylla collinsi* Kohls.—(B) *Myodopsylla palposa* (Rothschild).—(C) *Myodopsylla gentilis* Jordan & Rothschild.

of 1962–1964 was <0.6. This was from a sample of nine bats taken from a bridge over a small stream at Smartville on 8 June 1964. Our new records include collections from *A. pallidus* in all months but January, November, and December. Orr (1954) discussed pallid bat collecting data for the months of January, March, and December that indicated this bat remains in California in winter and moves into hibernacula. Gravid fleas were found on pallid bats in April, May, June, and August.

In Fig. 1B the symbols in Kern and Monterey Counties signify records that lack known localities.

4. *Myodopsylla collinsi* Kohls 1937
(Fig. 1A)

Myodopsylla collinsi Kohls, 1937, J. Parasitol. 23:300–302, Figs. 1, 2 (3 ♂♂, 4 ♀♀, Madera Canyon, Santa Rita Mountains, Santa Cruz County, Arizona, from bats).

Myodopsylla [?collinsi]. Stager, 1939, J. Mamm. 20:228.

Myodopsylla collinsi Kohls. Stager, 1943, J. Mamm. 24:198 (Lower Colorado River Valley in the vicinity of Blythe, from *Myotis occultus*, flea det. Kohls). Augustson, 1943, Bull. So. Calif. Acad. Sci. 42:86 (Riverside Mountains, Colorado River, from *Myotis velifer velifer*, Stager coll.). Hubbard, 1943, Pacif. Univ. Bull. 39(8):7. Hubbard, 1947, Fleas of Western North America, pp. 376, 383, 508. Hopkins & Rothschild, 1956, Catalogue of the Rothschild collection of Fleas in the British Museum (Natural History), Vol. II, p. 247 (1 ♂, 2 ♀♀, Riverside Co., Riverside Mountains, from *Myotis v. velifer*, Stager coll.). Lewis, 1974, J. Med. Ent. 11:530. Jellison & Senger in Taylor & Clark, 1976, Papers in Honor of Jerry Flora, p. 94 (1 ♀, Santa Cruz Is., from *Antrozous pallidus* [stray or catalogue error? Same locality, host, and date as most type specimens of *M. piercei* Augustson, 1941]; 1 ♂, 1 ♀, Blythe, from *Myotis occultus*; 2 ♂♂, 2 ♀♀, Riverside Co., from *Myotis velifer*; eight specimens, Laguna Dam, from

Myotis yumanensis). Lewis & Wilson, 1982, J. Med. Ent. 19:605. Lewis, 1978, J. Parasitol., 64:524–527.

Myodopsylla collensi (sic) Kohls. Ubelaker, 1966, Amer. Midland Nat. 75:201.

Total range.—Arizona, California, Kansas, Oklahoma, Texas, México (D.F., México, Michoacán, Morelos), Guatemala.

Additional California records.—Riverside County, Blythe: one ♀, *Myotis lucifugus,* 3.VIII.1947, J. McSwain, T. Fisher & R. Smith, det. V. J. Tipton (CDHVC) and two ♂♂, six ♀♀, same data but Acc. No. 2097 (GML); 24 km SW: six ♂♂, seven ♀♀, *M. lucifugus,* same date and collectors, det. Traub (DPF); ? km SW (abandoned mine): one ♂, one ♀, Bat, same date and collectors, det. Traub (DPF); 24 km SW (Mule Mountains): two ♂♂, three ♀♀, *M. lucifugus,* same date and collectors but Acc. No. 2097 (GML); W. Riverside Mountains, Mountaineer Mine: one ♀, *Myotis velifer,* 27.VIII.1958, [?A.J.B.], det. E. W. Jameson 1960 (CDHVC) and one ♀, same data but A. Beck coll. (FJR). San Bernardino County, Vidal, 3.2 km SW: one ♀, *M. velifer,* 30.VII.1961, A.J.B. (AJB).

Host synonymy.—*Myotis occultus* = *Myotis lucifugus occultus.*

Lewis (1974) concluded from reviewing literature on *M. collinsi* that it mainly parasitizes bats of the genus *Myotis,* usually *M. velifer.* This bat ranges as far west as southern California along the Colorado River (Stager 1939, Hall 1981). The leading host of *M. collinsi* in California, with 29 flea specimens recorded (only 10 from *M. velifer*) is *Myotis lucifugus occultus,* another bat that reaches its western limit in California near the Colorado River (Findley and Jones 1967, Hall 1981). Furthermore, there is only one collection from *Myotis yumanensis,* again along the Colorado River (Jellison and Senger 1976). Therefore, the record of one female from *Antrozous pallidus* on Santa Cruz Island (Jellison and Senger 1976; also see synonymy above) is anomalous for both its host (Table 1) and its geography (Fig. 1A). The pallid bat ranges widely in the Southwest (Hall 1981), and Orr (1954) indicated a lack of evidence that it seasonally migrates long distances.

5. *Myodopsylla gentilis* Jordan & Rothschild 1921
(Fig. 1C)

Myodopsylla gentilis Jordan & Rothschild, 1921, Ectoparasites 1:152 (4 ♂♂, 4 ♀♀, Okanagan Landing, British Columbia, from bat).

Myodopsylla gentilis Jordan & Rothschild. Stager, 1943, J. Mamm. 24:198 (Lower Colorado River Valley in the vicinity of Blythe, from *Myotis occultus,* fleas det. Kohls). Augustson, 1943, Bull. So. Calif. Acad. Sci. 42:86 (Riverside County, Blythe, Palo Verde Valley, Colorado River, from *M. occultus,* S. F. Wood coll.). Hubbard, 1943, Pacif. Univ. Bull. 39(8):7 (Lower Klamath Lake). Hubbard, 1947, Fleas of Western North America, pp. 374, 375, 508 (1 ♂, 1 ♀, Siskiyou County, Lower Klamath Lake, from *Myotis yamanensis* (sic) *sociabilis*). Holdenried, Evans & Longanecker, 1951, Ecol. Monogr. 21:11, 14 (up to 28 per collection, Alameda County, Calaveras Dam, from *Myotis yumanensis,* fleas det. P.Q.T.). Augustson & Wood, 1953, Bull. So. Calif. Acad. Sci. 52:49 (4 ♂♂, 10 ♀♀, Madera County, San Joaquin Experimental Range, from *M. yumanensis sociabilis*). Krutzsch, 1955, J. Mamm. 36:457 (one specimen, San Diego County near lower Otay Dam from *M. y. sociabilis*). Hopkins & Rothschild, 1956, Catalogue of the Rothschild Collection of Fleas in the British Museum (Natural History), Vol. II., p. 251 (1 ♀, Kern County, Fort Tejon, from *M. y. sociabilis*).

Smit, 1958, Proc. Ent. Soc. Wash. 60:176 (map with five localities in California). Jellison & Glesne, 1967, Index to the Literature of Siphonaptera of North America Suppl. 2, p. 209. Jellison & Senger in Taylor & Clark, 1976, Papers in Honor of Jerry Flora, pp. 94, 95 (2 ♂♂, 2 ♀♀, Blythe, from *M. occultus* [cf. Stager, 1943]; 7 ♂♂, 4 ♀♀, Alameda Co., from *M. yumanensis saturatus*; 12 ♂♂, 19 ♀♀, Laguna Dam, from *M. y. yumanensis*). Lewis & Wilson, 1982, J. Med. Ent. 19:605.

Total range.—Alaska, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Texas, Utah, Washington, Wyoming, Canada (British Columbia), México (D.F.).

Additional California records.—All from *Myotis yumanensis* except for one collection each from *M. evotis* and *T. brasiliensis*, two collections each from *M. thysanodes* and *A. pallidus*, and three collections from unidentified species as indicated below. Alameda County, Calaveras Dam: two ♂♂, 26 ♀♀, 16.VI.1943; two ♂♂, two ♀♀, 9.VII.1943; four ♂♂, four ♀♀, 10.VIII.1943; one ♂, two ♀♀, 9.IX.1943; four ♀♀, 13.IX.1943; and four ♂♂, four ♀♀, 9.III.1946. P.Q.T. (PQT, part); one ♂, one ♀, 16.VIII.1943; six ♂♂, 14 ♀♀, 24.VIII.1944; eight ♂♂, 20 ♀♀, 26.VIII.1944; and four ♂♂, eight ♀♀, 10.VI.1945, D. S. Longanecker. Amador County, Martell (Winton Lumber Co.): two ♂♂, one ♀, 22.VII.1964, A.J.B. (AJB); Plymouth, 9.7 km W: one ♀, 19.VII.1941, P.Q.T. (PQT). Colusa County, Wilbur Springs: one ♂, four ♀♀, 16.VIII.1960, Garcia & Radovsky, one ♀ det. Poorbaugh 1960 (CDHVC, other specimens FJR); two ♂♂, five ♀♀ (four gravid), 27.IV.1963; six ♂♂, 15 ♀♀ (nine gravid), 25.IV.1964; three ♂♂, 17 ♀♀ (three gravid), 16.V.1964; one ♂, four ♀♀ (one gravid), 29.VI.1964; one ♂, 11 ♀♀ (five gravid), 14.VIII.1964; and one ♀ (gravid), 12.IX.1964, A.J.B. (AJB); 10.4 km SE: five ♂♂, one ♀, 23.IX.1945, S. B. Benson. Humboldt County, [Hoopa Valley] Indian Reservation: one ♀, *Myotis* sp., 13.X.1953, R. Talmadge (GML). Lake County, Lucerne, Clear Lake: one ♀, 1.XII.1945, S. B. Benson; Sulfur Bank Mine, Sulfur Bank Pen., Clear Lake: two ♂♂, eight ♀♀, 24.VI.1964, A.J.B. (AJB). Los Angeles County, Azusa: one ♀, 5.IX.1942, D. G. Constantine, det. Augustson (LACM). Mono County, Mono Lake: one ♂, two ♀♀, 3.VIII.1961, and one ♂, two ♀♀, 22.VIII.1964, A.J.B. (AJB). Monterey County, Lucia, 3.2 km S (Limekiln Creek mouth): two ♀♀, 25.VI.1945, W. W. Dalquest; Soledad, 6.4 km S (Arroyo Seco Wash): one ♂, one ♀, *A. pallidus*, 25.VII.1936, J. C. VonBloeker (LACM). Napa County, Angwin, 0.8 km S: two ♀♀, *M. thysanodes*, 1.IV.1945, W. W. Dalquest; Calistoga, 3.2 km N & 1.6 km W (Tubbs Ranch): seven ♀♀, 30.VII.1955, K. F. Murray, det. A. M. Barnes 1956 (CDHVC no. 1950); 3.2 km N & 7.2 km W: two ♂♂, one ♀, *M. thysanodes*, 20.V.1955, K.F.M., det. A.M.B. 1956 (CDHVC no. 1840); and 5.6 km SE: one ♂, *Myotis evotis*, 21.V.1955, K.F.M., det. A.M.B. 1956 (CDHVC no. 1853); Pope Valley: one ♂, two ♀♀, 2.VI.1964, A.J.B. (AJB). Placer County: one ♂, one ♀, 21.IX.1945, S. B. Benson (CDCFC); Homewood, Lake Tahoe: 25 ♂♂, 21 ♀♀, 21.IX.1945, S.B.B., det. P.Q.T. 1945 (five ♂♂, five ♀♀, PQT & one ♂, one ♀, CDCFC); Tahoe City: one ♂, one ♀, bat, 3.VIII.1946, J. Kitley, det. P.T.J. (?Johnson) 1949 (CDHVC). Riverside County: one ♂, one ♀, *Myotis* sp.,—II.1951, R.W., det. E. Méndez 1953 (GML). San Diego County, Escondido: two ♀♀, 9.VI.1946, Krutzsch & Dixon, det. Traub (DPF); Lake Hodges: same data but one ♂, one ♀. San Francisco County, Golden Gate Park: two ♂♂, three ♀♀, 6.VII.1958 (per R. T. Orr) (CAS); San Francisco Zoo: two ♀♀, 6.VI.1958 and two ♀♀ (gravid). 10.VI.1958,

A.J.B. (AJB). Santa Cruz County, Big Basin, 6.4 km SW (Waddell Creek fork): 19 ♂♂, 35 ♀♀, 10.IX.1945, S. B. Benson, det. P.Q.T. (five ♂♂, five ♀♀, PQT). Siskiyou County, Lower Klamath Lake: one ♂, one ♀, 4.VII.1937, C. A. Hubbard (CAS); Montague (Hart Ranch): four ♂♂, two ♀♀, 20.VII.1964, A.J.B. (AJB). Sonoma County, Cloverdale: two ♂♂, four ♀♀, *A. pallidus,* 25.VII.1927, F. Tose & J. Mailliard, det. Prince & Good (one ♂, one ♀, N.E. Good & one ♂, three ♀♀, CAS); Glen Ellen, 0.8 km S: one ♀, *Tadarida* [*brasiliensis*], 1.VIII.1955, K. F. Murray, det. A. M. Barnes 1956 (CDHVC no. 1939-49). Tuolumne County, Jacksonville, 4 km ESE: four ♂♂, six ♀♀, 17.IX.1945, S. B. Benson, det. P.Q.T. (three ♂♂, five ♀♀, PQT). Yolo County, Capay, 11.2 km SW (Salt Creek): one ♂, 7.X.1964, A.J.B. (AJB); Woodland, 8 km N: one ♀, 28.IV.1961, A.J.B. (AJB). Yuba County, Smartville, 1.6 km E: one ♂, one ♀, 11.IX.1963 and one ♂, nine ♀♀ (gravid), 8.VI.1964, A.J.B. (AJB).

Host synonymy.—Myotis occultus = *M. lucifugus occultus.*

The western bat flea *M. gentilis* conspicuously leads all bat fleas of California in collections, specimens, and average numbers per bat examined. In addition, it has the widest distribution in the state (cf. Figs. 1A, B, and C). The most frequently recorded host was *Myotis yumanensis* (Yuma myotis), but along the Colorado River two (?three) collections were from *M. lucifugus* and one from the Yuma myotis. Bats of other genera (Table 1; also see records for Monterey and Sonoma Counties) are accidental hosts. The Yuma myotis is seldom observed in California in winter (Dalquest 1947). Consequently, *M. gentilis* was not recorded from this bat in January, February, and November, and only single collections were recorded in March (Alameda Co.), October (Yolo Co.), and December (Lake Co.). The majority of collections (such as 36 of the 43 additional records) of this flea from *M. yumanensis* occurred in June, July, August, and September.

The sample of 30 Yuma myotis (26 adult females) taken in a mine tunnel at Wilbur Springs, April to June 1964, was infested with an average of >1.5 specimens of *M. gentilis.* While the bats were being collected, some fleas became so agitated that they escaped, thereby depressing the calculated average infestation value. The roost area was heated by springs to over 30°C, and relative humidity was 85–95%. Gravid *M. gentilis* (23 of 53 females collected) occurred on the bats at Wilbur Springs throughout the collecting period, i.e., from late April to mid-September.

At Calaveras Dam 10 collections from 16 June 1943 to 9 March 1946 yielded 117 specimens of *M. gentilis* from a minimum of 87 Yuma myotis examined. That is, 85 bats were recorded, but totals for collections of 16 August 1943 and 10 June 1945 were not. Collections of 24 and 26 August 1944 were recorded in full (but not published) and yielded an average of 3.0 fleas per bat examined (n = 16). The bats roosted beneath the tile roof of the chlorine house. Full data for four of the six collections at Calaveras Dam incompletely reported by Holdenried et al. (1951) are included in the additional records. Collection dates are 16 June and 10 August 1943, 24 and 26 August 1944.

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